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Educational Television Series 1968-69

Teachers' Guide

DEPT. OF EDUCATION
HISTORICAL COLLECTION

Mathematics JUNIOR DIVISION

Mathematics Around Us

Educational Television Branch
ONTARIO DEPARTMENT OF EDUCATION
1670 Bayview Avenue, Toronto 17

MATHEMATICS

Junior Division

MATHEMATICS AROUND US

6 programs of 20 minutes each.

Designed for students in Grades 4 to 6. This series was formerly entitled "Mathematical Concepts" in the Synopsis of Programs.

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Scheduling for this series can be found in the monthly ETVO SCHEDULE sent to all teachers. For long-term planning, reference can be made to the ETV Schedule (Calendar), which lists programming from October to June and was mailed to all teachers. However, it is most important to check the monthly ETVO SCHEDULE for the last minute changes always involved in extensive programming.

INTRODUCTION

This series is designed to make students aware of mathematical structures and concepts as they occur in their environments, in nature, and in everyday activities. Accordingly, the series deals with the areas of symmetry, graphs, and mathematics found in everyday situations.

An intuitive approach is taken in the two programs on symmetry, focussing on the occurrence of reflective and rotational symmetry in nature and in man-made structures.

The basic concepts and principles of graphs are stressed in the next two programs and a variety of relationships among numbers are indicated. Practical examples of these concepts and relationships will be included, both from the world at large, and from the work of children in the classroom. Bar graphs are developed in Program three, and line graphs in Program four.

The final two programs draw attention to the occurrence of mathematics in activities carried on at such places as the service station and the supermarket. Here, the emphasis is on the practical application of mathematical concepts in familiar situations or experiences.

An attempt has been made to relate much of the mathematics to other subject areas in such a way as to encourage a wide variety of related follow-up activities. In all of these programs, it is hoped that the ideas and problems brought out, will suggest further exploration of these and similar mathematical concepts and experiences both inside and outside the classroom.

PROGRAM 1

ANY SYMMETRY IN SIGHT?

This program introduces many aspects of symmetry, as it is found in nature and in man-made structures.

PROGRAM CONTENT

Extensive use is made of visual materials which help children to focus on balanced forms in nature and in our everyday world; especially those forms which are distributed evenly on either side of a line of symmetry, and those which rotate about a point of symmetry. In some instances, the forms are superimposed over the object viewed, in others, they are indicated verbally, or simply presented visually for the viewer to observe and select. Thus, an intuitive awareness of these "forms-in-balance" is developed, leading up to a somewhat more mathematically oriented second program on symmetry.

SUGGESTED PRE-VIEWING ACTIVITIES

In view of the introductory nature of this program, pre-viewing activities are not recommended.

SUGGESTED POST-VIEWING ACTIVITIES

These suggestions are appropriate as post-viewing activities for either Programs one or two, or as pre-viewing activities for Program two.

1. Discuss examples of symmetry which the children point out, with particular reference to the reflective or rotational quality of each.
2. Encourage children to bring symmetrical objects into the classroom. Examples of symmetry in nature may be difficult to find in winter, but an abundance should be available in other seasons. Examples can be found in such places as the aquarium, on plants, in one's lunch, on a globe, or a light fixture.
3. Give the children opportunities to create symmetrical designs, pictures, or objects in art or craft work. Paint, crayons, modelling clay, plasticine, wire, papier maché, ink devils, paper sculpture, cut-outs or collage are a few of the media that can be used. Emphasis need not be on symmetrical form, as such. In discussing art work, symmetrical form could be pointed out in passing, where it appears.
4. Fold differently-shaped pieces of paper, or other materials, exactly in half as many ways as possible. The fold is the axis of symmetry. Note the shapes one gets when the paper is folded. How many axes has the square, the rectangle, the circle?

notes

PROGRAM 2

FUN WITH SYMMETRY

An understanding of the mathematical notions of reflection and rotation is developed, building upon the first program.

PROGRAM CONTENT

It would be most helpful to have viewed the first program, although it is not absolutely necessary.

The concept of reflective symmetry is developed by the use of film footage and the experiments of a boy and girl who are working on a poster printing problem. The special relationship of the right and left-handedness of an object and its reflection is considered, especially as it applies to printing, various man-made objects, and mirrored images. Another quality is seen in some of the objects used which leads us to consider familiar examples of rotational symmetry. A variety of objects are considered, which possess

either of these types of symmetry, both, or none (asymmetry).

SUGGESTED PRE-VIEWING ACTIVITIES

1. Any of the post-viewing activities suggested for Program one would be suitable.
2. Have the children bring mirrors, preferably hand mirrors with straight sides, as well as other reflectors. Reflectors can be made by wrapping foil around a piece of cardboard or wood. Some might be bent at right angles to reflect quarter sections of forms. A shiny metal box or cookie tin would also be useful. A firm sheet of clear plastic or acetate is useful for matching reflections of printed forms, and finding an axis of symmetry.
3. Make forms of cubes, cylinders, spheres, and pyramids, as exactly as possible, from clay or plasticine. Free forms provide a useful contrast. If clay is used, the forms should be completed two or three days before they are to be used to allow excess moisture to evaporate. After the program, the children can cut the forms into halves, in as many different ways as possible. A cheese cutter, piano or picture wire is best for cutting clay or plasticine. Wrap the ends of the wire around wooden pegs or pencils, and draw the wire through the clay.
4. Make a collection of styrofoam or similar material suitable for cutting large letters for forms, to be used for poster prints, etc.
5. Duplicate the page of forms enclosed in this guide so that each child has one to experiment with balanced reflections in mirrors or reflectors.

SUGGESTED POST-VIEWING ACTIVITIES

1. Cut the clay or plasticine forms in order to discover and demonstrate their axes of symmetry. Which forms have a reflective property, a rotational property, no symmetrical properties at all? Which forms are examples of both reflective and rotational symmetry?
2. Using mirrors or reflectors, make half of an apple (or other spherical shapes) whole again. To make a quarter apple whole again, use a cookie tin or reflector bent at right angles, or two mirrors joined at right angles.
3. Use mirrors, reflectors, or a piece of acetate with the printed forms on page 7 to find the lines of symmetry for each one. Do any of these forms lack symmetry? Let the children create their own forms, discover, and demonstrate their reflective or rotational properties. The axis or point of symmetry could be drawn in.
4. Experiment with materials and ideas that were on the program, or with ideas suggested by the children. Find reflections in mirrors, basins of water, lakes, pools, and windows, and test for vertical or horizontal symmetry.
5. The creation of mobiles is one way of illustrating forms in balance.
6. Let the children collect and display a variety of symmetrical objects.
7. Fold squared paper; draw a shape on one half, against the fold. Open the paper, and map the design or picture on the other half, plotting and joining corresponding points.
8. Print the following using capital letters, in such a way as to show an axis of symmetry.

   TOMATO 1881

   Use a mirror to test them. Encourage the children to make up some of their own and test their validity.
9. In what sense do the following words possess symmetry?

   RADAR MADAM

   Find other words that have the same quality.
10. Suggestions for post-viewing activities for the first program would also be appropriate for the second.

notes

PROGRAM 3

TRUTH BEHIND BARS

Through an inductive approach, the concepts and principles of graphing are established. Various practical applications of graphs are considered. The mathematical content receives more emphasis than in the two previous programs.

PROGRAM CONTENT

From the elementary one-to-one relationship of a simple graph, the program shows how the recording of larger quantities of information requires scaling of some sort. The bar graph is introduced as a type of "picture" chart, which is particularly suited to depicting and comparing static data.

Several practical and common examples are shown, both in and out of classroom settings. These lead up to a chart for depicting information which changes in time, with the possibility of projection and prediction of future trends. This is a prerequisite for the discussion of line graphs in the next program.

SUGGESTED PRE-VIEWING ACTIVITIES

Graphs need not be introduced as a series of lessons in themselves; rather they can relate to science, social studies, or other mathematics topics, as a means of presenting information the children have gathered in a easily readable form.

A supply of graph paper should be made available. If this is not possible a stencil of quarter inch squares can easily be drawn and duplicated. In view of the introductory nature of this program, further preparation is not considered necessary.

SUGGESTED POST-VIEWING ACTIVITIES

Bar graphs usually result from the desire to communicate data clearly in a form easily read. Thus, follow-up activities might well include creation of graphs to accompany social studies or science reports, experiments, or math projects.

1. If the children begin with pictographs, they can make surveys of different coloured socks worn by staff members, or the number of nylons compared with the number of socks; bicycles at school can be plotted according to colour, type, or those with or without gears, or in connection with a safety check (those safe and unsafe); colours of hair or eyes in the classroom, or among staff could also be plotted.

   If the children are working individually or in groups they may arrive at a variety of ways to depict the same information. It is important that they have an opportunity to discuss each other's graphs. A "White Paper" might well be prepared by each child constructing a graph, or each child in a group constructing a graph, which would include observations, conclusions (if any), and reservations about drawing conclusions or predictions.
2. Give the children a graph and ask them to write their interpretations with reasons.
3. Children can make work cards for their friends. These cards can be in the form of a graph to be interpreted, or of data to be graphed.
   a. In the former case, the child makes up questions on his graph. Answers and interpretive comments can be written by his friends. These can be discussed by all the children involved. The child drawing up the work card must previously do what he expects his friends to accomplish later. There will be considerable variation; for example, one child graphing how much time he spends in various activities during the day may plot time for sleeping, eating, playing, reading, and watching television, whereas another child may include shopping, delivering papers, washing dishes, and telephoning.
   b. A child can make up a list of data to be graphed and interpreted by his friends after he himself has worked it out.

notes

PROGRAM 4

A MOVING PLOT

Following the program on bar graphs, this one introduces the special qualities of line graphs, with emphasis on ordered pairs, the grid system, and plotting sets of points on the cartesian plane.

PROGRAM CONTENT

Students are made aware of the particular suitability of line graphs for plotting data which changes over a period of time, enabling one to project trends. Ordered pairs are introduced, indicating the first or horizontal component, and the second or vertical component. The idea of a grid is related to practical examples, and the use of ordered pairs in locating sites on a grid is expanded and illustrated. Plotting points on a cartesian plane follows, and some of the special rules and effects are demonstrated and related to practical applications.

SUGGESTED PRE-VIEWING ACTIVITIES

It would be useful to construct some bar graphs which would lend themselves readily to line graphing. A bar graph depicting the number of pets belonging to children in the class would be of no value as a line graph because there is no relationship between the points plotted. There is no dynamic movement or trend from one point to the others. To plot the outdoor temperature every half hour for a few hours, provides a trend, making it possible to predict the next reading, as well as allowing for verification.

1. The children themselves might see the advantage or alternative, of plotting and joining points. If not, it will be brought to their attention in the program. Other topics which could be graphed at this stage might include: the length of a shadow measured every half hour; the height of a candle measured at regular intervals.
2. An exercise in readings of below and above zero temperatures might be helpful in leading into the use of co-ordinates.
3. Locating places on a map or global grid is not recommended, as the order of map co-ordinates is the opposite of mathematical co-ordinates.
4. Map the seats in the classroom and describe the location of several desks, using co-ordinates.

SUGGESTED POST-VIEWING ACTIVITIES

The following are some suggestions for line graphs. Graphs related to the students' personal experiences and experiments are recommended rather than those based on book work.

1. Measure the length of a melting icicle at regular intervals. Compare the length of the icicle to the time intervals.
2. Plot over a week the number of cars or vehicles passing the school during the same quarter or half hour each day. Compare the number of vehicles with the days of the week.
3. Advanced students will find ways of plotting graphs showing the time required to fill containers of different shapes.
4. Plot the average monthly rainfall for a year in your area. Compare the curve this gives you with those obtained for rainfall in Vancouver, Cairo, Calcutta, etc.
5. Write out all of the pairs of factors

of a number such as 16 or 24, and plot them. Compare the curves.

6. More advanced students might enjoy plotting a consecutive series of numbers along one axis, and the reciprocals of these numbers along the other.
7. Many children will enjoy plotting pictures. They can draw simple outlines on graph paper and note the co-ordinates for other children to use. An example follows: (-1,8), (0,6), (1,4), (3,0), (6,-5), (1,-5), (0,-1), (-1,-5), (-6,-5), (-3,0), (-1,4), (0,6), (1,8).
8. A scale drawing can be made from a picture by lightly superimposing a grid over it and repeating it in a scaled-down or scaled-up size, on a blank sheet of paper. The same principle applies to the copying and scaling of a map or part of a map. It is important to realize that scaling can be useful for either increasing or decreasing the size.
9. Work cards, similar to those suggested for the last program, could be made up by the children for each other.

notes

PROGRAM 5

AT YOUR SERVICE

This program draws attention to the variety of mathematics found at a service station, and familiarizes students with some of their particular operations and applications.

PROGRAM CONTENT

A boy takes his flat bicycle tire to the local service station for help. He does not have the money necessary for a new tube. The owner is very busy, however he offers to fix the tire if the boy will help by doing odd jobs around the station. This gives the boy an opportunity to become acquainted with the many practices which are common to this kind of business, and to work with many of the applications of mathematics. These applications include calculations, making change, bills, credit cards, as well as considering volume, measuring gauges, wrench and tire sizes. No attempt is made to deal with these applications in depth, since it is hoped that children will pursue those that interest them after the telecast.

SUGGESTED PRE-VIEWING ACTIVITIES

1. A class discussion concerning the varied operations of a service station, might bring out many of the applications of mathematics. Some of these will be dealt with in the program, others can be pursued further by interested groups or individuals.
2. It would be helpful if children had some familiarity with the concepts of air pressure and the displacement of gas or liquid.

SUGGESTED POST-VIEWING ACTIVITIES

1. Make arrangements for interested groups, individuals or the class as a whole to visit a garage. Such a visit should be purposeful, with a search for definite information or demonstrations in mind. Resulting information should be reported and/or demonstrated to the class with time for discussion of findings.
2. Visit an automotive diagnostic centre, or a safety check centre to survey the types of tests performed and equipment used. This will likely be too complicated for children at this stage. However, tests using bicycles may be suggested, and could be conducted at school. Groups could be formed to choose, develop, and explain a test or series of tests on bicycles. These tests might include any of the following suggestions:

   – speedometer accuracy test – using a speedometer and a stop watch over a measured distance. Distance can be determined from the circumference of the bicycle tire.
   – mileage test – test accuracy of odometer, measure circumference of tire, determine the number of revolutions required to kick over the odometer (1 mile or 1/10 of a mile?); verify this.
   – brake test – test distance required for stopping from either a specified speed at a specified point, or a fixed point on a hill. Are some types of brakes better than others?
   – air pressure test – measurement with and without the bicycle rider. What is the relationship between high and low tire pressure and the pedalling effort required?
   – lubrication and function of bearings test – roll freely down a hill; measure distance covered before and after lubrication, and with riders of different weights.

   Other tests can be devised by the children.

notes

PROGRAM 6

SHOPPING FOR MATHS

This shopping trip to a supermarket draws attention to the variety of mathematical notions to be found there.

PROGRAM CONTENT

A husband sets out to show his wife how to shop for groceries scientifically, and thus save money. Mathematics is brought into the program incidentally, as they make their way through the store. They adopt a tallying system and round off prices to keep track of the total cost of their groceries. A weight-price chart on a set of scales is examined, and the prices of various products are compared in relation to size of package, weight, and several economic factors. The program also touches upon the principle of the cash register's operation, making change, packaging and estimating.

SUGGESTED PRE-VIEWING ACTIVITIES

Here again, a general discussion may be the best introduction. Different methods of shopping could be examined with respect to the use of a list, the memory or impulse buying. Do you keep track of the costs of the selected items to avoid overspending? How? How do you decide to buy a certain size, brand, or within a certain price range of products, such as soap or breakfast food? How many packages of different shapes are found in a supermarket? Does there appear to be any reason for this or for the different kinds of materials used for packaging?

SUGGESTED POST-VIEWING ACTIVITIES

1. Can the children think of any easier or more accurate method of tallying?

2. School funds might be made available to allow each child a small sum of money to spend experimentally. Have each child bring to school the merchandise thus purchased, and compare relative values.

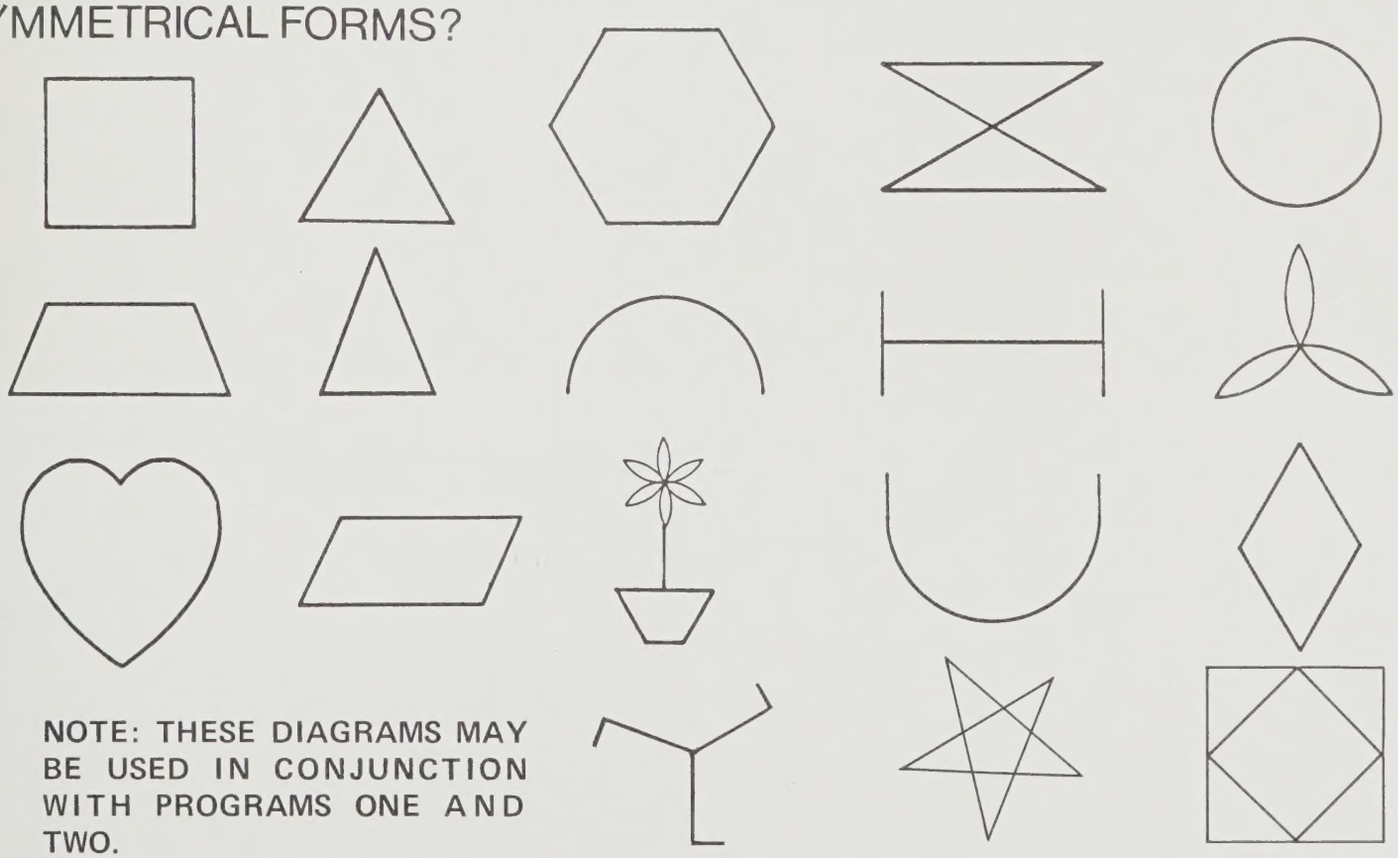
3. A common shopping list could be made up by the children. They could go to the supermarket in groups or individually to tally up the total cost, and find the "best buys". Comparisons and discussion of values would follow.

4. At the supermarket children might have an opportunity to weigh meat or fruit, and learn how to use the price chart on the scales. A set of these scales might be borrowed for use in the school.

5. Different shapes used in packaging and different ways of stocking, shelving or displaying merchandise could be noted. Discuss any possible reasons for the shapes and materials used in packaging.

notes

SYMMETRICAL FORMS?



NOTE: THESE DIAGRAMS MAY BE USED IN CONJUNCTION WITH PROGRAMS ONE AND TWO.

MATHEMATICS AROUND US